

PART P STEEL ERECTION

WAC 296-155-701 Scope.

- (1) (a) This part applies to employers involved in the construction, alteration and repair of single or multistory buildings, bridges, and a variety of other structures. This part applies to employers involved in steel erection unless specifically excluded.
- (b) Examples of steel erection structures include, but are not limited to:

Aerialways;	Aerospace facilities and structures;
Air and cable supported structures;	Amphitheaters;
Amusement park structures and rides;	Aqueducts;
Artistic and monumental structures;	Atriums;
Auditoriums;	Balconies;
Billboards;	Bins;
Bridges;	Canopies;
Car dumpers;	Catwalks;
Chemical process structures;	Conveyor supports and related framing;
Conveyor systems;	Cranes and craneways;
Curtain walls;	Draft curtains;
Elevator fronts;	Energy exploration structures;
Energy production, transfer and storage structures and facilities;	Entrances;
Fire containment structures;	Fire escapes;
Furnaces;	Geodesic domes;
Hi-bay structures;	Hoppers;
Industrial structures;	Lift slab/tilt-up structures;
Light towers;	Malls;
Metal roofs;	Mills;
Monorails;	Ovens;
Overpasses;	Penthouses;
Platforms;	Power plants;
Racks and rack support structures and frames;	Radar and communication structures;

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Rail, marine and other transportation structures;	Scoreboards;
Signage;	Single and multistory buildings;
Skylights;	Sound barriers;
Space frames;	Stackers/reclaimers;
Stacks;	Stadiums;
Stair towers;	Stairways;
Store fronts;	Systems-engineered metal buildings;
Trestles;	Underpasses;
Viaducts;	Water process and water containment structures; and
Window walls.	

(2) (a) Covered steel erection work includes the:

- Hoisting, laying out, placing, connecting, welding, burning, guying, bracing, bolting, plumbing and rigging of structural steel, steel joists, and metal buildings; and
- Installing metal decking, curtain walls, window walls, siding systems, miscellaneous metals, ornamental iron and similar materials.

(b) The following work is also covered by this part when done during, and are a part of, steel erection work:

Anchoring devices;	Building equipment;
Building specialties;	Cable stays;
Castings;	Cold formed steel framing;
Column covers;	Conveying systems;
Crane rails and accessories;	Detention or security equipment and doors, windows and hardware;
Doors; windows;	Elevator beams;
Enclosures and pockets;	Falsework for temporary supports of permanent steel members;
Fascias;	Fences and gates;
Ferrous metals and alloys;	Floor plates;
Gaskets;	Glass;
Gratings;	Grillage;

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Handrails;	Hardware;
Hydraulic structures;	Joint fillers;
Ladders;	Louvers;
Metal decking and raceway systems and accessories;	Metal panels and panel wall systems;
Metal roofing and accessories;	Metal siding; bridge flooring;
Miscellaneous, architectural and ornamental metals and metal work;	Multipurpose supports;
Nonferrous metals and alloys;	Ornamental iron work, expansion control including bridge expansion joint assemblies;
Penthouse enclosures;	Perforated metals;
Permanent and temporary bents and towers;	Plastics and synthetic composite materials;
Railings;	Rigging, hoisting, laying out, placing, connecting, guying, bracing, dismantling, burning, welding, bolting, grinding, sealing, caulking, and all related activities for construction, alteration and/or repair of materials and assemblies such as structural steel;
Safety systems for steel erection;	Sealants and seals;
Sheet metal fabrications;	Shelf racks;
Skylights;	Slide bearings;
Soffit panels;	Stairs;
Steel and metal joists;	Stone and other nonprecast concrete architectural materials mounted on steel frames;
Structural cabling;	Structural metal framing and related bracing and assemblies; and
Trench covers.	

- (3) Controlling contractor duties are specified in WAC 296-155-703 (1) and (3), 296-155-707 (2)(b), 296-155-714(2), and 296-155-716(5).
[Statutory Authority: RCW 49.17.010, .040, .050. 02-13-115 (Order 01-36), § 296-155-701, filed 06/19/02, effective 09/01/02].

WAC 296-155-702 Definitions.

Anchored bridging means that the steel joist bridging is connected to a bridging terminus point.

Bolted diagonal bridging means diagonal bridging that is bolted to a steel joist or joists.

Bridging clip means a device that is attached to the steel joist to allow the bolting of the bridging to the steel joist.

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Bridging terminus point means a wall, a beam, tandem joists (with all bridging installed and a horizontal truss in the plane of the top chord) or other element at an end or intermediate point(s) of a line of bridging that provides an anchor point for the steel joist bridging.

Choker means a wire rope or synthetic fiber rigging assembly that is used to attach a load to a hoisting device.

Cold forming means the process of using press brakes, rolls, or other methods to shape steel into desired cross sections at room temperature.

Column means a load-carrying vertical member that is part of the primary skeletal framing system. Columns do not include posts.

Competent person (also defined in WAC 296-155-012) means one who can identify existing or predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization or authority by nature of their position to take prompt corrective measures to eliminate them. The person must be knowledgeable of the requirements of this part.

Connector means someone who, working with hoisting equipment, is placing and connecting structural members and/or components.

Constructibility means the ability to erect structural steel members in accordance with this part without having to alter the overall structural design.

Construction load (for joist erection) means any load other than the weight of the employee(s), the joists and the bridging bundle.

Controlled load-lowering means lowering a load by means of a mechanical hoist drum device that allows a load to be lowered with maximum control using the gear train or hydraulic components of the hoist mechanism. Controlled load lowering requires the use of the hoist drive motor, rather than the load hoist brake, to lower the load.

Controlling contractor means a prime contractor, general contractor, construction manager or any other legal entity that has the overall responsibility for the construction of the project--its planning, quality and completion.

Critical lift means a lift that:

- Exceeds seventy-five percent of the crane or derrick rated load chart capacity; or
- Requires the use of more than one crane or derrick.

Derrick floor means an elevated floor of a building or structure that has been designated to receive hoisted pieces of steel prior to final placement.

Double connection means an attachment method where the connection point is intended for two pieces of steel that share common bolts on either side of a central piece.

Double connection seat means a structural attachment that, during the installation of a double connection, supports the first member while the second member is connected.

Employee (and other terms of like meaning, unless the context of the provision containing such a term indicates otherwise) means an employee of an employer who is employed in the business of his or her employer whether by way of manual labor or otherwise and every person in this state who is engaged in the employment of or who is working under an independent contract the essence of which is personal labor for an employer under this standard whether by way of manual labor or otherwise.

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Employer means any person, firm, corporation, partnership, business trust, legal representative, or other business entity which engages in any business, industry, profession, or activity in this state and employs one or more employees or who contracts with one or more persons, the essence of which is the personal labor of such person or persons and includes the state, counties, cities, and all municipal corporations, public corporations, political subdivisions of the state, and charitable organizations: Provided, That any persons, partnership, or business entity not having employees, and who is covered by the Industrial Insurance Act must be considered both an employer and an employee.

Erection bridging means the bolted diagonal bridging that is required to be installed prior to releasing the hoisting cables from the steel joists.

Final interior perimeter means the perimeter of a large permanent open space within a building such as an atrium or courtyard. This does not include openings for stairways, elevator shafts, etc.

Floor hole (decking hole) means an opening measuring less than twelve inches but more than one inch in its least dimension in any floor, roof, or platform through which materials but not persons may fall, such as a belt hole, pipe opening, or slot opening.

Girt (in systems-engineered metal buildings) means a “Z” or “C” shaped member formed from sheet steel spanning between primary framing and supporting wall material.

Headache ball means a weighted hook that is used to attach loads to the hoist load line of the crane.

Hoisting equipment means lifting equipment designed to lift and position a load of known weight to a location at some known elevation and horizontal distance from the equipment's center of rotation. Hoisting equipment includes, but not limited to:

- Cranes;
- Derricks;
- Tower cranes;
- Barge-mounted derricks or cranes;
- Gin poles; and
- Gantry hoist systems.

Note: A come-a-long (a mechanical device, usually consisting of a chain or cable attached at each end, that is used to facilitate movement of materials through leverage) is not considered hoisting equipment.

Metal decking means a commercially manufactured, structural grade, cold rolled metal panel formed into a series of parallel ribs and includes metal floor and roof decks, standing seam metal roofs, other metal roof systems and other products such as bar gratings, checker plate, expanded metal panels, and similar products. After installation and proper fastening, these decking materials serve a combination of functions including: A structural element designed in combination with the structure to resist, distribute and transfer loads, stiffen the structure and provide a diaphragm action; a walking/working surface; a form for concrete slabs; a support for roofing systems; and a finished floor or roof.

Multiple lift rigging means a rigging assembly manufactured by wire rope rigging suppliers that facilitates the attachment of up to five independent loads to the hoist rigging of a crane.

Must means mandatory.

Permanent floor means a structurally completed floor at any level or elevation (including slab on grade).

WAC 296-155-702 (Cont.)

Post means a structural member with a longitudinal axis that is essentially vertical, that:

- Weighs three hundred pounds or less and is axially loaded (a load presses down on the top end); or
- Is not axially loaded, but is laterally restrained by the above member. Posts typically support stair landings, wall framing, mezzanines and other substructures.

Project structural engineer of record means the registered, licensed professional responsible for the design of structural steel framing and whose seal appears on the structural contract documents.

Purlin (in systems-engineered metal buildings) means a “Z,” “C,” or “W” shaped member formed from sheet steel spanning between primary framing and supporting roof material.

Qualified person means one who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training, and experience, has successfully demonstrated the ability to solve or resolve problems relating to the subject matter, the work, or the project.

Safety deck attachment means an initial attachment that is used to secure an initially placed sheet of decking to keep proper alignment and bearing with structural support members.

Shear connector means headed steel studs, steel bars, steel lugs, and similar devices which are attached to a structural member for the purpose of achieving composite action with concrete.

Steel erection means the construction, alteration or repair of steel buildings, bridges and other structures, including the installation of metal decking and all planking used during the process of erection.

Steel joist means an open web, secondary load-carrying member of one hundred forty-four feet (43.9 m) or less, designed by the manufacturer, used for the support of floors and roofs. This does not include structural steel trusses or cold-formed joists.

Steel joist girder means an open web, primary load-carrying member, designed by the manufacturer, used for the support of floors and roofs. This does not include structural steel trusses.

Steel truss means an open web member designed of structural steel components by the project structural engineer of record. For the purposes of this subpart, a steel truss is considered equivalent to a solid web structural member.

Structural steel means a steel member, or a member made of a substitute material (such as, but not limited to, fiberglass, aluminum or composite members). These members include, but are not limited to, steel joists, joist girders, purlins, columns, beams, trusses, splices, seats, metal decking, girts, and all bridging, and cold formed metal framing which is integrated with the structural steel framing of a building.

Systems-engineered metal building means a metal, field-assembled building system consisting of framing, roof and wall coverings. Typically, many of these components are cold-formed shapes. These individual parts are fabricated in one or more manufacturing facilities and shipped to the job site for assembly into the final structure. The engineering design of the system is normally the responsibility of the systems-engineered metal building manufacturer.

Tank means a container for holding gases, liquids or solids.

You means the employer.

[Statutory Authority: RCW 49.17.010, .040, .050. 02-13-115 (Order 01-36), § 296-155-702, filed 06/19/02, effective 09/01/02].

WAC 296-155-703 Site layout, site-specific erection plan and construction sequence.

- (1) Before steel erection work can start the controlling contractor must ensure the steel erector is provided written notifications that:
 - (a) The concrete in the footings, piers and walls and the mortar in the masonry piers and walls has attained either:
 - Seventy-five percent of the intended minimum compressive design strength; or
 - Sufficient strength to support the loads imposed during steel erection.

The basis of these measurements is the appropriate ASTM standard test method of field cured samples.

 - (b) Any repairs, replacements and modifications to the anchor bolts were done per WAC 296-155-707(2).
- (2) The steel erector must receive written notice that the concrete in the footings, piers and walls or the mortar in the masonry piers and walls has attained, on the basis of an appropriate ASTM standard test method of field-cured samples, either seventy-five percent of the intended minimum compressive design strength or sufficient strength to support the loads imposed during steel erection.
- (3) **Site layout.** The controlling contractor must ensure that the following is provided and maintained:
 - (a) Adequate access roads into and through the site for the safe delivery and movement of derricks, cranes, trucks, other necessary equipment, and the material to be erected and means and methods for pedestrian and vehicular control.

Exception: This requirement does not apply to roads outside the construction site.

- (b) A firm, properly graded, drained area, readily accessible to the work with adequate space for the safe storage of materials and the safe operation of the erector's equipment.
- (4) **Preplanning of overhead hoisting operations.** All hoisting operations in steel erection must be preplanned to ensure that the requirements of WAC 296-155-704(4) are met.
- (5) **Site-specific erection plan.** Where employers elect, due to conditions specific to the site, to develop alternate means and methods that provide employee protection in accordance with WAC 296-155-704 (3)(e), 296-155-709 (1)(d) or (5)(d), a site-specific erection plan must be developed by a qualified person and be available at the worksite. Guidelines for establishing a site-specific erection plan are contained in Appendix A to this part.
- (6) Steel erection must be done under the supervision of a competent person who is present at the worksite. [Statutory Authority: RCW 49.17.010, .040, .050. 02-13-115 (Order 01-36), § 296-155-703, filed 06/19/02, effective 09/01/02].

WAC 296-155-704 Hoisting and rigging.

- (1) All the provisions of WAC 296-155-525 and 296-155-526 apply to hoisting and rigging.
- (2) In addition, subsections (3) through (5) of this section apply regarding the hazards associated with hoisting and rigging.

WAC 296-155-704 (Cont.)

(3) General.

- (a) Crane preshift visual inspection.
 - (i) Cranes being used in steel erection activities must be visually inspected prior to each shift by a competent person. The inspection must include observation for deficiencies during operation and, as a minimum, must include:
 - All control mechanisms for maladjustments;
 - Control and drive mechanism for excessive wear of components and contamination by lubricants, water or other foreign matter;
 - Safety devices, including boom angle indicators, boom stops, boom kick out devices, anti-two block devices, and load movement indicators where required;
 - Air, hydraulic, and other pressurized lines for deterioration or leakage, particularly those which flex in normal operation;
 - Hooks and latches for deformation, chemical damage, cracks, or wear;
 - Wire rope reeving for compliance with hoisting equipment manufacturer's specifications;
 - Electrical apparatus for malfunctioning, signs of excessive deterioration, dirt, or moisture accumulation;
 - Hydraulic system for proper fluid level;
 - Tires for proper inflation and condition;
 - Ground conditions around the hoisting equipment for proper support, including ground settling under and around outriggers, ground water accumulation, or similar conditions;
 - The hoisting equipment for level position; and
 - The hoisting equipment for level position after each move and setup.
 - (ii) If any deficiency is identified, an immediate determination must be made by the competent person if the deficiency constitutes a hazard.
 - (iii) If the deficiency constitutes a hazard, the hoisting equipment must be removed from service until the deficiency has been corrected.
 - (iv) The operator is responsible for those operations under their direct control. Whenever there is any doubt as to safety, the operator must have the authority to stop and refuse to handle loads until safety has been assured.
- (b) A qualified rigger (a rigger who is also a qualified person) must inspect the rigging prior to each shift in accordance with WAC 296-155-330.
- (c) The headache ball, hook or load must not be used to transport personnel, except as provided in (d) of this subsection.
- (d) Cranes or derricks may be used to hoist employees on a personnel platform when work under this part is being conducted if all the provisions of WAC 296-155-525 through 296-155-528 are met.
- (e) Safety latches on hooks must not be deactivated or made inoperable except:

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- (i) When a qualified rigger has determined that the hoisting and placing of purlins and single joists can be performed more safely by doing so; or
- (ii) When equivalent protection is provided in a site-specific erection plan.

(4) Working under loads.

- (a) Routes for suspended loads must be preplanned to ensure that no employee works directly below a suspended load except when:
 - (i) Engaged in the initial connection of the steel; or
 - (ii) Necessary for the hooking or unhooking of the load.
- (b) When working under suspended loads, the following criteria must be met:
 - (i) Materials being hoisted must be rigged to prevent unintentional displacement;
 - (ii) Hooks with self-closing safety latches or their equivalent must be used to prevent components from slipping out of the hook; and
 - (iii) All loads must be rigged by a qualified rigger.

(5) Multiple lift rigging procedure.

- (a) A multiple lift must only be performed if the following criteria are met:
 - A multiple lift rigging assembly is used;
 - A multiple lift is only permitted when specifically within the manufacturer's specifications and limitations;
 - A maximum of five members are hoisted per lift;

Exception: Bundles of decking must not be lifted using the multiple lift rigging procedure, even though they meet the definition of structural members in WAC 296-155-702.

- Only beams and similar structural members are lifted; and
 - All employees engaged in the multiple lift have been trained in these procedures in accordance with WAC 296-155-717 (3)(a).
- (b) Components of the multiple lift rigging assembly must be specifically designed and assembled with a maximum capacity for total assembly and for each individual attachment point. This capacity, certified by the manufacturer or a qualified rigger, must be based on the manufacturer's specifications with a five to one safety factor for all components.
- (c) The total load must not exceed:
 - The rated capacity of the hoisting equipment specified in the hoisting equipment load charts; and
 - The rigging capacity specified in the rigging-rating chart.

WAC 296-155-704 (Cont.)

- (d) The multiple lift rigging assembly must be rigged with members:
 - Attached at their center of gravity and maintained reasonably level;
 - Rigged from top down; and
 - Rigged at least seven feet (2.1 m) apart.
- (e) The members on the multiple lift rigging assembly must be set from the bottom up.
- (f) Controlled load lowering must be used whenever the load is over the connectors.
[Statutory Authority: RCW 49.17.010, .040, .050. 02-13-115 (Order 01-36), § 296-155-704, filed 06/19/02, effective 09/01/02].

WAC 296-155-706 Structural steel assembly.

- (1) Structural stability must be maintained at all times during the erection process.
 - Make sure that multistory structures have the following:
 - Permanent floors installed as the erection of structural members progress;
 - No more than eight stories between the erection floor and the upper-most permanent floor; and
 - No more than four floors or forty-eight feet (14.6 m), whichever is less, of unfinished bolting or welding above the foundation or uppermost permanent secured floor.

Exception: The above applies except where the structural integrity is maintained as a result of design.

(2) Walking/working surfaces.

- (a) Shear connectors and other similar devices.
 - (i) Shear connectors, reinforcing bars, deformed anchors or threaded studs must not be attached to the top flanges of beams, joists or beam attachments so they project vertically from or horizontally across the top flange of the member until after the metal decking, or other walking/working surface has been installed. This becomes a tripping hazard. Examples of shear connectors are headed steel studs, steel bars or steel lugs.
 - (ii) Installation of shear connectors on composite floors. When shear connectors are used in construction of composite floors, roofs and bridge decks, employees must lay out and install the shear connectors after the metal decking has been installed, using the metal decking as a working platform.
- (b) Slip resistance of metal decking. (Reserved.)
- (c) Workers must not be permitted to walk the top surface of any structural steel member installed after July 18, 2006, that has been coated with paint or similar material. Except when documentation or certification is provided that the coating has achieved a minimum average slip resistance of .50 when measured with an English XL tribometer or equivalent tester on a wetted surface at a testing laboratory is provided. Such documentation or certification must be based on the appropriate ASTM standard test method conducted by a laboratory capable of performing the test. The results must be available at the site and to the steel erector. (Appendix B to this part references appropriate ASTM standard test methods that may be used to comply with this requirement.)

WAC 296-155-706 (Cont.)

- (d) Safe access must be provided to the working level. Employees must not slide down ropes, columns, or ladders.
- (3) **Plumbing-up.**
 - (a) When deemed necessary by a competent person, plumbing-up equipment must be installed in conjunction with the steel erection process to ensure the stability of the structure.
 - (b) When used, plumbing-up equipment must be in place and properly installed before the structure is loaded with construction material such as loads of joists, bundles of decking or bundles of bridging.
 - (c) Plumbing-up equipment must be removed only with the approval of a competent person.
- (4) **Metal decking.**
 - (a) Hoisting, landing and placing of metal decking bundles.
 - (i) Bundle packaging and strapping must not be used for hoisting unless specifically designed for that purpose.
 - (ii) If loose items such as dunnage, flashing, or other materials are placed on the top of metal decking bundles to be hoisted, such items must be secured to the bundles.
 - (iii) Bundles of metal decking on joists must be landed in accordance with WAC 296-155-709 (5)(d).
 - (iv) Metal decking bundles must be landed on framing members so that enough support is provided to allow the bundles to be unbanded without dislodging the bundles from the supports.
 - (v) At the end of the shift or when environmental or job site conditions require, metal decking must be secured against displacement.
 - (b) Roof and floor holes and openings. Metal decking at roof and floor holes and openings must be installed as follows:
 - (i) Framed metal deck openings must have structural members turned down to allow continuous deck installation except where not allowed by structural design constraints or constructibility.
 - (ii) Roof and floor holes and openings must be decked over. Where large size, configuration or other structural design does not allow openings to be decked over (such as elevator shafts, stair wells, etc.) employees must be protected in accordance with chapter 296-155 WAC, Part C-1 or Part K.
 - (iii) Metal decking holes and openings must not be cut until immediately prior to being permanently filled with the equipment or structure needed or intended to fulfill its specific use and which meets the strength requirements of (c) of this subsection, or must be immediately covered.

WAC 296-155-706 (Cont.)

- (c) **Covering roof and floor openings.** Smoke dome or skylight fixtures that have been installed are not considered covers for the purpose of this section unless they meet the strength requirements of WAC 296-155-505 (4)(g) (Part K).
- (d) **Decking gaps around columns.** Wire mesh, exterior plywood, or equivalent, must be installed around columns where planks or metal decking do not fit tightly. The materials used must be of sufficient strength to provide fall protection for personnel and prevent objects from falling through.
- (e) **Installation of metal decking.**
 - (i) Metal decking must be laid tightly and immediately secured upon placement to prevent accidental movement or displacement.
 - (ii) During initial placement, metal decking panels must be placed to ensure full support by structural members.
- (f) **Derrick floors.**
 - (i) A derrick floor must be fully decked and or planked and the steel member connections completed to support the intended floor loading.
 - (ii) Temporary loads placed on a derrick floor must be distributed over the underlying support members so as to prevent local overloading of the deck material.
[Statutory Authority: RCW 49.17.010, .040, .050. 02-13-115 (Order 01-36), § 296-155-706, filed 06/19/02, effective 09/01/02].

WAC 296-155-707 Column anchorage.

- (1) **General requirements for erection stability.**
 - (a) All columns must be anchored by a minimum of four anchor rods (anchor bolts).
 - (b) Each column anchor rod (anchor bolt) assembly, including the column-to-base plate weld and the column foundation, must be designed to resist a minimum eccentric gravity load of three hundred pounds (136.2 kg) located eighteen inches (.46 m) from the extreme outer face of the column in each direction at the top of the column shaft.
 - (c) Columns must be set on level finished floors, pregrouted leveling plates, leveling nuts, or shim packs which are adequate to transfer the construction loads.
 - (d) All columns must be evaluated by a competent person to determine whether guying or bracing is needed; if guying or bracing is needed, it must be installed.
- (2) **Repair, replacement or field modification of anchor rods (anchor bolts).**
 - (a) Anchor rods (anchor bolts) must not be repaired, replaced or field-modified without the approval of the project structural engineer of record.
 - (b) Prior to the erection of a column, the controlling contractor must provide written notification to the steel erector if there has been any repair, replacement or modification of the anchor rods (anchor bolts) of that column.
[Statutory Authority: RCW 49.17.010, .040, .050. 02-13-115 (Order 01-36), § 296-155-707, filed 06/19/02, effective 09/01/02].

WAC 296-155-708 Beams and columns.

(1) General.

- (a) During the final placing of solid web structural members, the load must not be released from the hoisting line until the members are secured with at least two bolts per connection. These bolts must be of the same size and strength as shown in the erection drawings, drawn up wrench-tight or the equivalent as specified by the project structural engineer of record.

Exception: See subsection (2) of this section.

- (b) A competent person must determine if more than two bolts are necessary to ensure the stability of cantilevered members; if additional bolts are needed, they must be installed.
- (2) **Diagonal bracing.** Solid web structural members used as diagonal bracing must be secured by at least one bolt per connection drawn up wrench-tight or the equivalent as specified by the project structural engineer of record.
- (3) (a) **Double connections at columns and/or at beam webs over a column.**
When two structural members on opposite sides of a column web, or a beam web over a column, are connected sharing common connection holes, at least one bolt with its wrench-tight nut must remain connected to the first member unless a shop-attached or field-attached seat or equivalent connection device is supplied with the member to secure the first member and prevent the column from being displaced (see Appendix E to this part for examples of equivalent connection devices).
- (b) If a seat or equivalent device is used, the seat (or device) must be designed to support the load during the double connection process. It must be adequately bolted or welded to both a supporting member and the first member before the nuts on the shared bolts are removed to make the double connection.
- (4) **Column splices.** Each column splice must be designed to resist a minimum eccentric gravity load of three hundred pounds (136.2 kg) located eighteen inches (.46 m) from the extreme outer face of the column in each direction at the top of the column shaft.
- (5) **Perimeter columns.** Perimeter columns must not be erected unless:
- (a) The perimeter columns extend a minimum of forty-eight inches (1.2 m) above the finished floor to permit installation of perimeter safety cables prior to erection of the next tier, except where constructibility does not allow (see Appendix D to this part);
 - (b) The perimeter columns have holes or other devices in or attached to perimeter columns at forty-two to forty-five inches (107-114 cm) above the finished floor and the midpoint between the finished floor and the top cable to permit installation of perimeter safety cables required by WAC 296-155-716 (1)(b), except where constructibility does not allow. (See Appendix D to this part.)
[Statutory Authority: RCW 49.17.010, .040, .050. 02-13-115 (Order 01-36), § 296-155-708, filed 06/19/02, effective 09/01/02].

WAC 296-155-709 Open web steel joists.

(1) General.

- (a) Where steel joists are used and columns are not framed in at least two directions with solid web structural steel members, a steel joist must be field-bolted at the column to provide lateral stability to the column during erection.

WAC 296-155-709 (Cont.)

Exception: See (b) of this subsection. For the installation of this joist:

- (i) A vertical stabilizer plate must be provided on each column for steel joists. The plate must be a minimum of six inch by six inch (152 mm by 152 mm) and must extend at least three inches (76 mm) below the bottom chord of the joist with a 13/16-inch (21 mm) hole to provide an attachment point for guying or plumbing cables.
- (ii) The bottom chords of steel joists at columns must be stabilized to prevent rotation during erection.
- (iii) Hoisting cables must not be released until the seat at each end of the steel joist is field-bolted, and each end of the bottom chord is restrained by the column stabilizer plate.
- (b) Where constructibility does not allow a steel joist to be installed at the column:
 - (i) An alternate means of stabilizing joists must be installed on both sides near the column and must:
 - Provide stability equivalent to (a) of this subsection;
 - Be designed by a qualified person;
 - Be shop installed; and
 - Be included in the erection drawings.
 - (ii) Hoisting cables must not be released until the seat at each end of the steel joist is field-bolted and the joist is stabilized.
- (c) Where steel joists at or near columns span sixty feet (18.3 m) or less, the joist must be designed with sufficient strength to allow one employee to release the hoisting cable without the need for erection bridging.
- (d) Where steel joists at or near columns span more than sixty feet (18.3 m), the joists must be set in tandem with all bridging installed unless an alternative method of erection, which provides equivalent stability to the steel joist, is designed by a qualified person and is included in the site-specific erection plan.
- (e) A steel joist or steel joist girder must not be placed on any support structure unless such structure is stabilized.
- (f) When steel joist(s) are landed on a structure, they must be secured to prevent unintentional displacement prior to installation.
- (g) No modification that affects the strength of a steel joist or steel joist girder must be made without the approval of the project structural engineer of record.
- (h) Field-bolted joists.
 - (i) Except for steel joists that have been preassembled into panels, connections of individual steel joists to steel structures in bays of forty feet (12.2 m) or more must be fabricated to allow for field bolting during erection.
 - (ii) These connections must be field-bolted unless constructibility does not allow.

WAC 296-155-709 (Cont.)

- (i) Steel joists and steel joist girders must not be used as anchorage points for a fall arrest system unless written approval to do so is obtained from a qualified person.
 - (j) A bridging terminus point must be established before bridging is installed. (See Appendix E to this part.)
- (2) **Attachment of steel joists and steel joist girders.**
- (a) Each end of “K” series steel joists must be attached to the support structure with a minimum of two 1/8-inch (3 mm) fillet welds one inch (25 mm) long or with two 1/2-inch (13 mm) bolts, or the equivalent.
 - (b) Each end of “LH” and “DLH” series steel joists and steel joist girders must be attached to the support structure with a minimum of two 1/4-inch (6 mm) fillet welds two inches (51 mm) long, or with two 3/4-inch (19 mm) bolts, or the equivalent.
 - (c) Except as provided in (d) of this subsection, each steel joist must be attached to the support structure, at least at one end on both sides of the seat, immediately upon placement in the final erection position and before additional joists are placed.
 - (d) Panels that have been preassembled from steel joists with bridging must be attached to the structure at each corner before the hoisting cables are released.
- (3) **Erection of steel joists.**
- (a) Both sides of the seat of one end of each steel joist that requires bridging under Tables A and B must be attached to the support structure before hoisting cables are released.
 - (b) For joists over sixty feet, both ends of the joist must be attached as specified in subsections (2) and (4) of this section before the hoisting cables are released.
 - (c) On steel joists that do not require erection bridging under Tables A and B, only one employee must be allowed on the joist until all bridging is installed and anchored.

Table A--Erection of Bridging for Short Span Joists

Joist	Span		Joist	Span		Joist	Span
8L1	NM		22K10	40-0		14KCS1	NM
10K1	NM		22K11	40-0		14KCS2	NM
12K1	23-0		24K4	36-0		14KCS3	NM
12K3	NM		24K5	38-0		16KCS2	NM
12K5	NM		24K6	39-0		16KCS3	NM
14K1	27-0		24K7	43-0		16KCS4	NM
14K3	NM		24K8	43-0		16KCS5	NM

WAC 296-155-709 (Cont.)

14K4	NM		24K9	44-0		18KCS2	35-0
14K6	NM		24K10	NM		18KCS3	NM
16K2	29-0		24K12	NM		18KCS4	NM
16K3	30-0		26K5	38-0		18KCS5	NM
16K4	32-0		26K6	39-0		20KCS2	36-0
16K5	32-0		26K7	43-0		20KCS3	39-0
16K6	NM		26K8	44-0		20KCS4	NM
16K7	NM		26K9	45-0		20KCS5	NM
16K9	NM		26K10	49-0		22KCS2	36-0
18K3	31-0		26K12	NM		22KCS3	40-0
18K4	32-0		28K6	40-0		22KCS4	NM
18K5	33-0		28K7	43-0		22KCS5	NM
18K6	35-0		28K8	44-0		24KCS2	39-0
18K7	NM		28K9	45-0		24KCS3	44-0
18K9	NM		28K10	49-0		24KCS4	NM
18K10	NM		28K12	53-0		24KCS5	NM
20K3	32-0		30K7	44-0		26KCS2	39-0
20K4	34-0		30K8	45-0		26KCS3	44-0
20K5	34-0		30K9	45-0		26KCS4	NM
20K6	36-0		30K10	50-0		26KCS5	NM
20K7	39-0		30K11	52-0		28KCS2	40-0
20K9	39-0		30K12	54-0		28KCS3	45-0
20K10	NM		10KCS1	NM		28KCS4	53-0
22K4	34-0		10KCS2	NM		28KCS5	53-0
22K5	35-0		10KCS3	NM		30KCS3	45-0
22K6	36-0		12KCS1	NM		30KCS4	54-0
22K7	40-0		12KCS2	NM		30KCS5	54-0
22K9	40-0		12KCS3	NM			

NM = Diagonal bolted bridging not mandatory for joists under 40 feet.

WAC 296-155-709 (Cont.)

Table B--Erection Bridging for Long Span Joists

Joist	Span		Joist	Span
18LH02	33-0		28LH06	42-0
18LH03	NM		28LH07	NM
18LH04	NM		28LH08	NM
18LH05	NM		28LH09	NM
18LH06	NM		28LH10	NM
18LH07	NM		28LH11	NM
18LH08	NM		28LH12	NM
18LH09	NM		28LH13	NM
20LH02	33-0		32LH06	47-0 through 60-0
20LH03	38-0		32LH07	47-0 through 60-0
20LH04	NM		32LH08	55-0 through 60-0
20LH05	NM		32LH09	NM through 60-0
20LH06	NM		32LH10	NM through 60-0
20LH07	NM		32LH11	NM through 60-0
20LH08	NM		32LH12	NM through 60-0
20LH09	NM		32LH13	NM through 60-0
20LH10	NM		32LH14	NM through 60-0
24LH03	35-0		32LH15	NM through 60-0
24LH04	39-0		36LH07	47-0 through 60-0
24LH05	40-0		36LH08	47-0 through 60-0
24LH06	45-0		36LH09	57-0 through 60-0
24LH07	NM		36LH10	NM through 60-0
24LH08	NM		36LH11	NM through 60-0
24LH09	NM		36LH12	NM through 60-0
24LH10	NM		36LH13	NM through 60-0
24LH11	NM		36LH14	NM through 60-0
28LH05	42-0		36LH15	NM through 60-0

NM = Diagonal bolted bridging not mandatory for joists under 40 feet.

WAC 296-155-709 (Cont.)

- (d) Employees must not be allowed on steel joists where the span of the steel joist is equal to or greater than the span shown in Tables A and B except in accordance with WAC 296-155-709(4).
- (e) When permanent bridging terminus points cannot be used during erection, additional temporary bridging terminus points are required to provide stability. (See Appendix E of this part.)

(4) Erection bridging.

- (a) Where the span of the steel joist is equal to or greater than the span shown in Tables A and B, the following must apply:
 - (i) A row of bolted diagonal erection bridging must be installed near the midspan of the steel joist;
 - (ii) Hoisting cables must not be released until this bolted diagonal erection bridging is installed and anchored; and
 - (iii) No more than one employee must be allowed on these spans until all other bridging is installed and anchored.
- (b) Where the span of the steel joist is over sixty feet (18.3 m) through one hundred feet (30.5 m), the following must apply:
 - (i) All rows of bridging must be bolted diagonal bridging;
 - (ii) Two rows of bolted diagonal erection bridging must be installed near the third points of the steel joist;
 - (iii) Hoisting cables must not be released until this bolted diagonal erection bridging is installed and anchored; and
 - (iv) No more than two employees must be allowed on these spans until all other bridging is installed and anchored.
- (c) Where the span of the steel joist is over one hundred feet (30.5 m) through one hundred forty-four feet (43.9 m), the following must apply:
 - (i) All rows of bridging must be bolted diagonal bridging;
 - (ii) Hoisting cables must not be released until all bridging is installed and anchored; and
 - (iii) No more than two employees must be allowed on these spans until all bridging is installed and anchored.
- (d) For steel members spanning over one hundred forty-four feet (43.9 m), the erection methods used must be in accordance with WAC 296-155-708.
- (e) Where any steel joist specified in subsections (3)(b), (4)(a), (b), and (c) of this section is a bottom chord bearing joist, a row of bolted diagonal bridging must be provided near the support(s). This bridging must be installed and anchored before the hoisting cable(s) is released.

WAC 296-155-709 (Cont.)

- (f) When bolted diagonal erection bridging is required by this section, the following must apply:
 - (i) The bridging must be indicated on the erection drawing;
 - (ii) The erection drawing must be the exclusive indicator of the proper placement of this bridging;
 - (iii) Shop-installed bridging clips, or functional equivalents, must be used where the bridging bolts to the steel joists;
 - (iv) When two pieces of bridging are attached to the steel joist by a common bolt, the nut that secures the first piece of bridging must not be removed from the bolt for the attachment of the second; and
 - (v) Bridging attachments must not protrude above the top chord of the steel joist.

(5) Landing and placing loads.

- (a) During the construction period, the employer placing a load on steel joists must ensure that the load is distributed so as not to exceed the carrying capacity of any steel joist.
- (b) Except for (d) of this subsection, no construction loads are allowed on the steel joists until all bridging is installed and anchored and all joist-bearing ends are attached.
- (c) The weight of a bundle of joist bridging must not exceed a total of one thousand pounds (454 kg). A bundle of joist bridging must be placed on a minimum of three steel joists that are secured at one end. The edge of the bridging bundle must be positioned within one foot (.30 m) of the secured end.
- (d) No bundle of decking may be placed on steel joists until all bridging has been installed and anchored and all joist bearing ends attached, unless all of the following conditions are met:
 - (i) The employer has first determined from a qualified person and documented in a site-specific erection plan that the structure or portion of the structure is capable of supporting the load;
 - (ii) The bundle of decking is placed on a minimum of three steel joists;
 - (iii) The joists supporting the bundle of decking are attached at both ends;
 - (iv) At least one row of bridging is installed and anchored;
 - (v) The total weight of the bundle of decking does not exceed four thousand pounds (1816 kg); and
 - (vi) Placement of the bundle of decking must be in accordance with (e) of this subsection.
- (e) The edge of the construction load must be placed within one foot (.30 m) of the bearing surface of the joist end.
[Statutory Authority: RCW 49.17.010, .040, .050. 02-13-115 (Order 01-36), § 296-155-709, filed 06/19/02, effective 09/01/02].

WAC 296-155-711 Systems-engineered metal buildings.

- (1) All of the requirements of this part apply to the erection of systems-engineered metal buildings except WAC 296-155-707 (column anchorage) and WAC 296-155-709 (open web steel joists).
- (2) Each structural column must be anchored by a minimum of four anchor rods (anchor bolts).
- (3) Rigid frames must have fifty percent of their bolts or the number of bolts specified by the manufacturer (whichever is greater) installed and tightened on both sides of the web adjacent to each flange before the hoisting equipment is released.
- (4) Construction loads must not be placed on any structural steel framework unless such framework is safely bolted, welded or otherwise adequately secured.
- (5) In girt and eave strut-to-frame connections, when girts or eave struts share common connection holes, at least one bolt with its wrench-tight nut must remain connected to the first member unless a manufacturer-supplied, field-attached seat or similar connection device is present to secure the first member so that the girt or eave strut is always secured against displacement.
- (6) Both ends of all steel joists or cold-formed joists must be fully bolted and/or welded to the support structure before:
 - (a) Releasing the hoisting cables;
 - (b) Allowing an employee on the joists; or
 - (c) Allowing any construction loads on the joists.
- (7) Purlins and girts must not be used as an anchorage point for a fall arrest system unless written approval is obtained from a qualified person.
- (8) Purlins may only be used as a walking/working surface when installing safety systems, after all permanent bridging has been installed and fall protection is provided.
- (9) Construction loads may be placed only within a zone that is within eight feet (2.5 m) of the center line of the primary support member.
[Statutory Authority: RCW 49.17.010, .040, .050. 02-13-115 (Order 01-36), § 296-155-711, filed 06/19/02, effective 09/01/02].

WAC 296-155-714 Falling object protection.

- (1) Securing loose items aloft. All materials, equipment, and tools, which are not in use while aloft, must be secured against accidental displacement.
- (2) Protection from falling objects other than materials being hoisted. The controlling contractor must bar other construction processes below steel erection unless overhead protection for the employees below is provided.
[Statutory Authority: RCW 49.17.010, .040, .050. 02-13-115 (Order 01-36), § 296-155-714, filed 06/19/02, effective 09/01/02].

WAC 296-155-716 Fall protection.

- (1) **General requirements.**
 - (a) Fall protection will be in accordance with chapter 296-155 WAC, Parts C-1 and K.

WAC 296-155-716 (Cont.)

- (b) During steel erection activities, fall protection must be as required by chapter 296-155 WAC, Parts C-1 and K. Additionally, on multistory structures, perimeter safety cables must be installed at the final interior and exterior perimeters of the floors as soon as metal decking has been installed. See Appendix D.
- (2) **Connectors.** Each connector must: Have completed connector training in accordance with WAC 296-155-717.
- (3) **Custody of fall protection.** Fall protection provided by the steel erector must remain in the area where steel erection activity has been completed, to be used by other trades, only if the controlling contractor or its authorized representative:
 - (a) Has directed the steel erector to leave the fall protection in place; and
 - (b) Has inspected and accepted control and responsibility of the fall protection prior to authorizing persons other than steel erectors to work in the area.
[Statutory Authority: RCW 49.17.010, .040, .050. 02-13-115 (Order 01-36), § 296-155-716, filed 06/19/02, effective 09/01/02].

WAC 296-155-717 Training.

- (1) **Training personnel.** Training required by this section must be provided by a qualified person(s).
- (2) **Fall hazard training.** The employer must provide a training program for all employees exposed to fall hazards as required by chapter 296-155 WAC, Part C-1.
- (3) **Special training programs.** In addition to the training required in subsection (2) of this section, the employer must provide special training to employees engaged in the following activities:
 - (a) Multiple lift rigging procedure. The employer must ensure that each employee who performs multiple lift rigging has been provided training in the following areas:
 - (i) The nature of the hazards associated with multiple lifts; and
 - (ii) The proper procedures and equipment to perform multiple lifts required by WAC 296-155-704(5).
 - (b) Connector procedures. The employer must ensure that each connector has been provided training in the following areas:
 - (i) The nature of the hazards associated with connecting (see Appendix D for nonmandatory training guidelines); and
 - (ii) The establishment, access, proper connecting techniques, double connections, and work practices, required by WAC 296-155-708(3) and Part C-1, chapter 296-155 WAC.
[Statutory Authority: RCW 49.17.010, .040, .050. 02-13-115 (Order 01-36), § 296-155-717, filed 06/19/02, effective 09/01/02].

WAC 296-155-72401 Appendix A-Guidelines for establishing the components of a site-specific erection plan: Nonmandatory guidelines for complying with WAC 296-155-703(5).

- (1) General. This appendix serves as a guideline to assist employers who elect to develop a site-specific erection plan in accordance with WAC 296-155-703(5) with alternate means and methods to provide employee protection in accordance with WAC 296-155-704 (3)(e) and 296-155-709 (5)(d).
- (2) Development of a site-specific erection plan. Pre-construction conference(s) and site inspection(s) are held between the erector and the controlling contractor, and others such as the project engineer and fabricator before the start of steel erection. The purpose of such conference(s) is to develop and review the site-specific erection plan that will meet the requirements of this section.
- (3) Components of a site-specific erection plan. In developing a site-specific erection plan, a steel erector considers the following elements:
 - (a) The sequence of erection activity, developed in coordination with the controlling contractor, that includes the following:
 - (i) Material deliveries;
 - (ii) Material staging and storage; and
 - (iii) Coordination with other trades and construction activities.
 - (b) A description of the crane and derrick selection and placement procedures, including the following:
 - (i) Site preparation;
 - (ii) Path for overhead loads; and
 - (iii) Critical lifts, including rigging supplies and equipment.
 - (c) A description of steel erection activities and procedures, including the following:
 - (i) Stability considerations requiring temporary bracing and guying;
 - (ii) Erection bridging terminus point;
 - (iii) Anchor rod (anchor bolt) notifications regarding repair, replacement and modifications;
 - (iv) Columns and beams (including joists and purlins);
 - (v) Connections;
 - (vi) Decking; and
 - (vii) Ornamental and miscellaneous iron.
 - (d) A description of the fall protection procedures that will be used to comply with Part C-1, chapter 296-155 WAC.
 - (e) A description of the procedures that will be used to comply with WAC 296-155-714.

WAC 296-155-72401 (Cont.)

- (f) A description of the special procedures required for hazardous nonroutine tasks.
 - (g) A certification for each employee who has received training for performing steel erection operations as required by WAC 296-155-717.
 - (h) A list of the qualified and competent persons.
 - (i) A description of the procedures that will be utilized in the event of rescue or emergency response.
- (4) Other plan information. The plan:
- (a) Includes the identification of the site and project; and
 - (b) Is signed and dated by the qualified person(s) responsible for its preparation and modification.
[Statutory Authority: RCW 49.17.010, .040, .050. 02-13-115 (Order 01-36), § 296-155-72401, filed 06/19/02, effective 09/01/02].

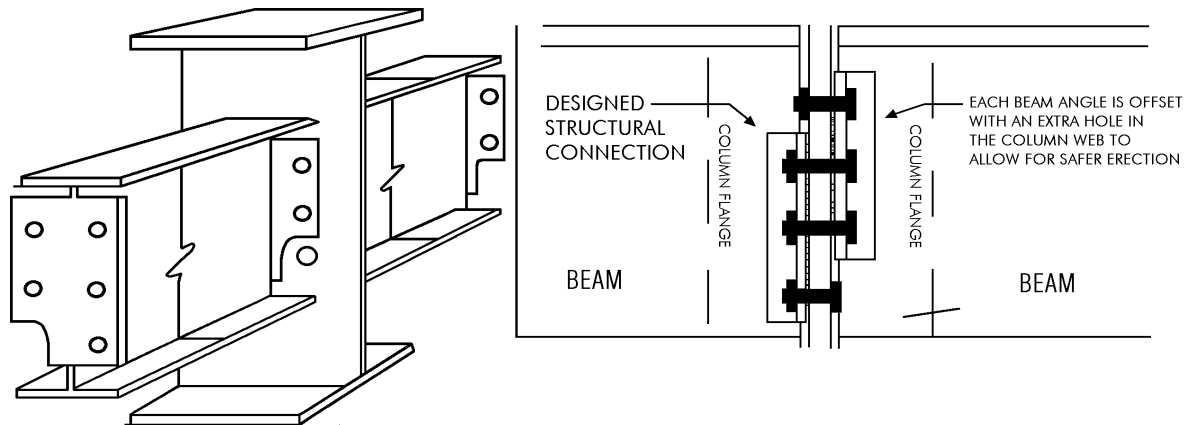
WAC 296-155-72402 Appendix B-Acceptable test methods for testing slip-resistance of walking/working surfaces. Nonmandatory guidelines for complying with WAC 296-155-706 (2)(c). The following references provide acceptable test methods for complying with the requirements of WAC 296-155-706 (2)(c). *Standard test method for using a portable inclineable articulated strut slip tester (PIAST)(ASTM F1677-96) *standard test method for using a variable incidence tribometer (VIT)(ASTM F1679-96).
[Statutory Authority: RCW 49.17.010, .040, .050. 02-13-115 (Order 01-36), § 296-155-72402, filed 06/19/02, effective 09/01/02].

WAC 296-155-72403 Appendix C-Training: Nonmandatory guidelines for complying with WAC 296-155-717. The training requirements of WAC 296-155-717 will be deemed to have been met if employees have completed a training course on steel erection, including instruction in the provisions of this WAC that has been approved by the U.S. Department of Labor Apprenticeship Training Employer Labor Services or an approved state apprenticeship council. A training program may include the following:

- Multiple lift rigging procedures;
- Structural steel assembly;
- Open web steel joists;
- Panelized joist election;
- Preengineered metal buildings;
- Installation of steel decking; and
- Site conditions and construction sequence.
[Statutory Authority: RCW 49.17.010, .040, .050. 02-13-115 (Order 01-36), § 296-155-72403, filed 06/19/02, effective 09/01/02].

WAC 296-155-72404 Appendix D-Perimeter columns: Nonmandatory guidelines for complying with WAC 296-155-708(5). To protect the unprotected side or edge of a walking/working surface in multistory structures, when holes in the column web are used for perimeter safety cables, the column splice must be placed sufficiently high so as not to interfere with any attachments to the column necessary for the column splice. Column splices are recommended to be placed at every other or fourth levels as design allows. Column splices at third levels are detrimental to the erection process and should be avoided if possible.
[Statutory Authority: RCW 49.17.010, .040, .050. 02-13-115 (Order 01-36), § 296-155-72404, filed 06/19/02, effective 09/01/02].

WAC 296-155-72405 Appendix E-Double connections: Illustrations of a clipped end connection and a staggered connection: Nonmandatory guidelines for complying with WAC 296-155-708 (3)(a).



[Statutory Authority: RCW 49.17.010, .040, .050. 02-13-115 (Order 01-36), § 296-155-72405, filed 06/19/02, effective 09/01/02].

WAC 296-155-72406 Appendix F-Typical installations for bridging: Nonmandatory guidelines for complying with chapter 296-155 WAC. Employers must comply with fall restraint and fall arrest as stated in Part C-1, chapter 296-155 WAC.

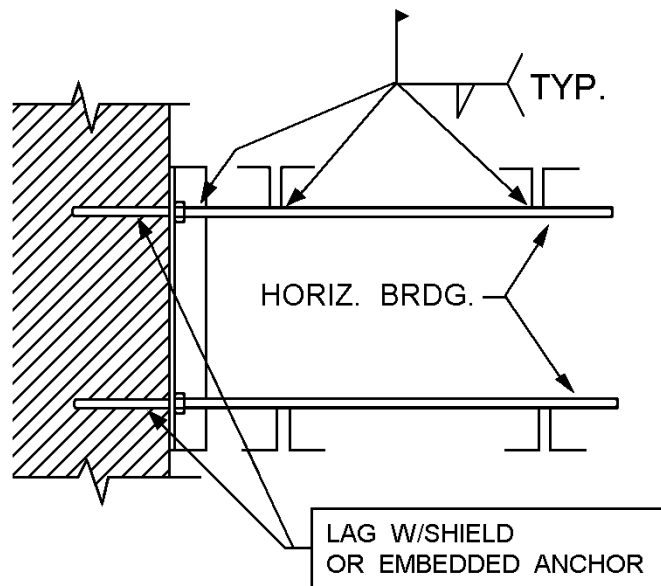


Illustration 1 – HORIZONTAL BRIDGING – TERMINUS AT WALL

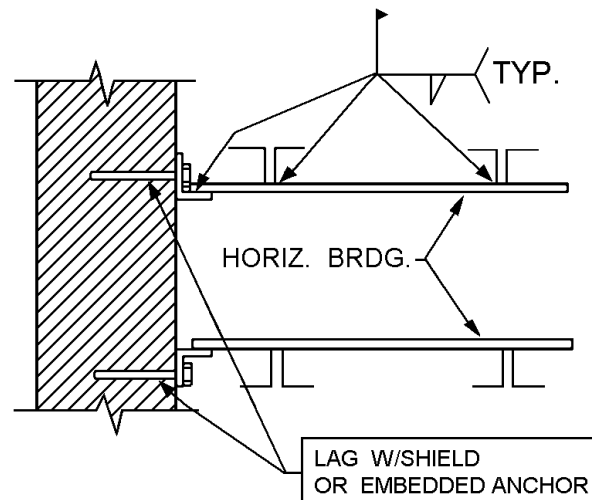


Illustration 2 – HORIZONTAL BRIDGING – TERMINUS AT WALL

WAC 296-155-72406 (Cont.)

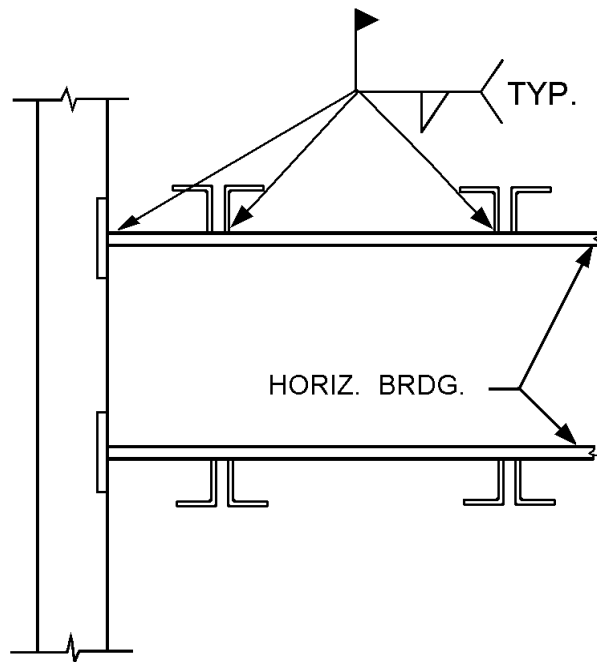


Illustration 3 – **HORIZONTAL BRIDGING – TERMINUS AT PANEL WALL**

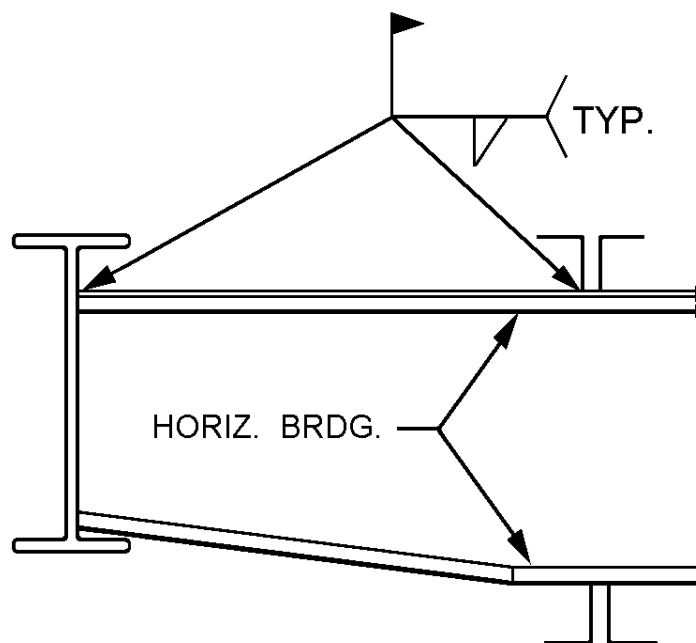


Illustration 4 – **HORIZONTAL BRIDGING – TERMINUS AT STRUCTURAL SHAPE**

WAC 296-155-72406 (Cont.)

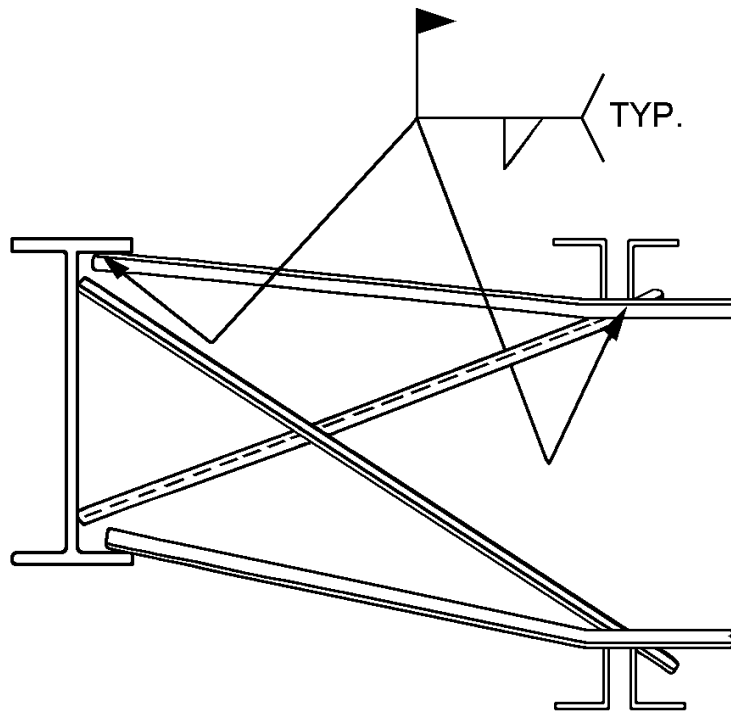


Illustration –5 **HORIZONTAL BRIDGING – TERMINUS AT STRUCTURAL SHAPE
WITH OPTIONAL “X-BRIDGING**

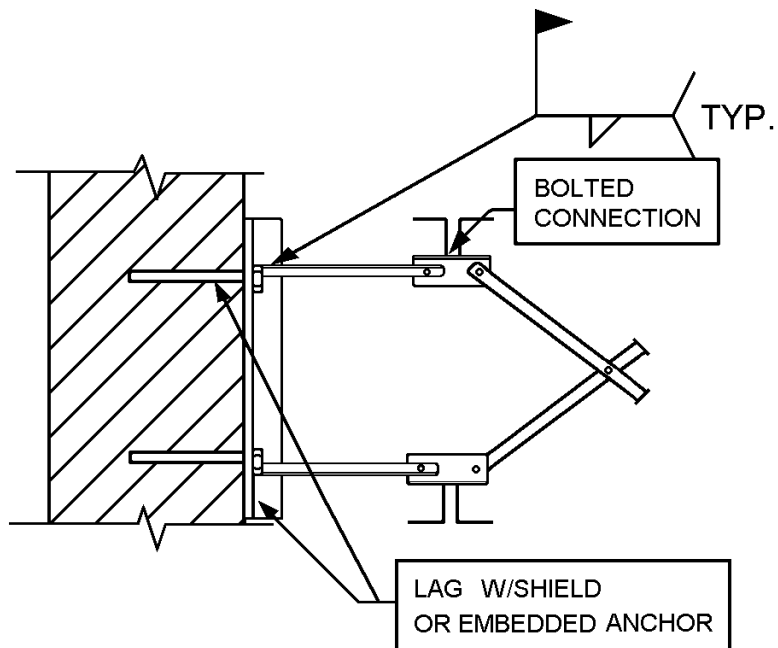


Illustration 6 – **BOLTED DIAGONAL BRIDGING – TERMINUS AT WALL**

WAC 296-155-72406 (Cont.)

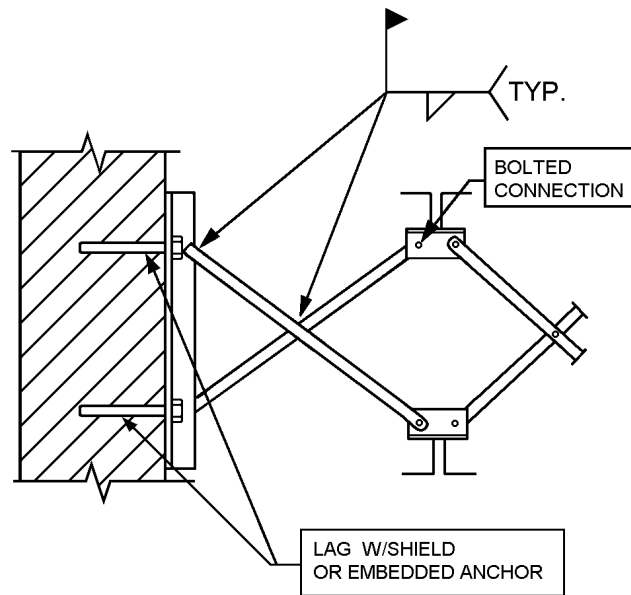


Illustration 7 – **BOLTED DIAGONAL BRIDGING – TERMINUS AT WALL**

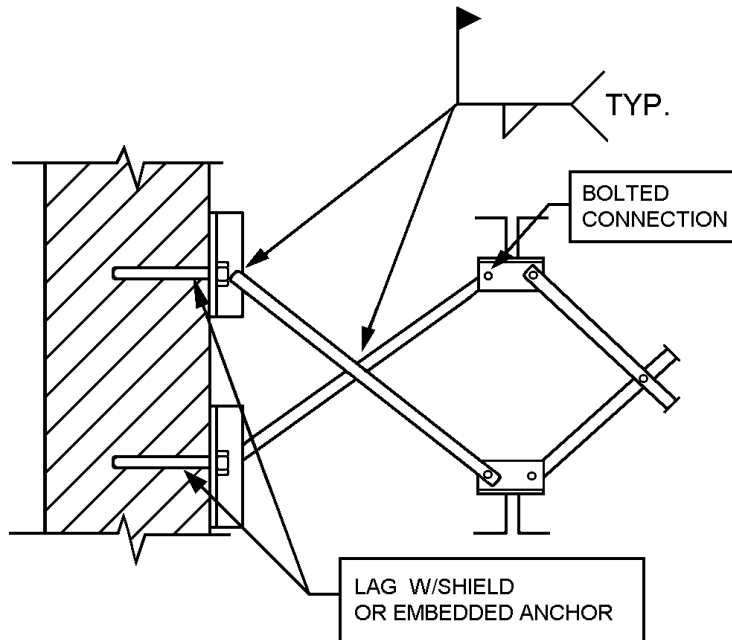


Illustration 8 – **BOLTED DIAGONAL BRIDGING – TERMINUS AT WALL**

WAC 296-155-72406 (Cont.)

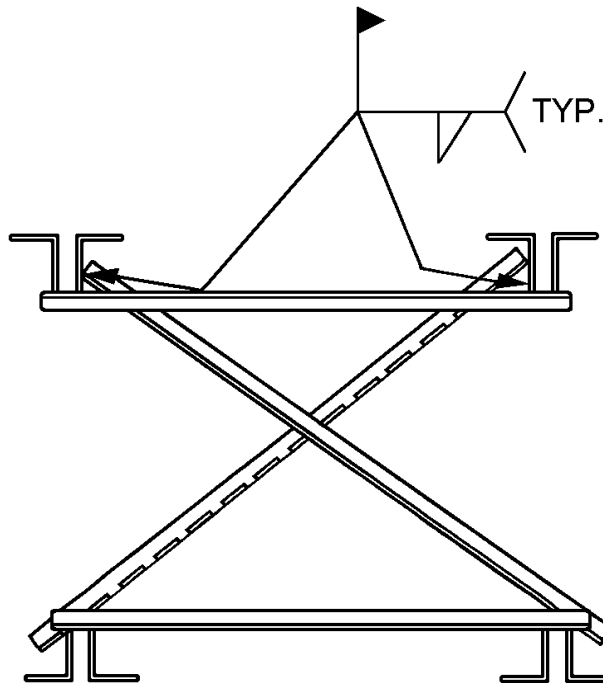


Illustration 9 – JOINT PAIR BRIDGING – TERMINUS POINT

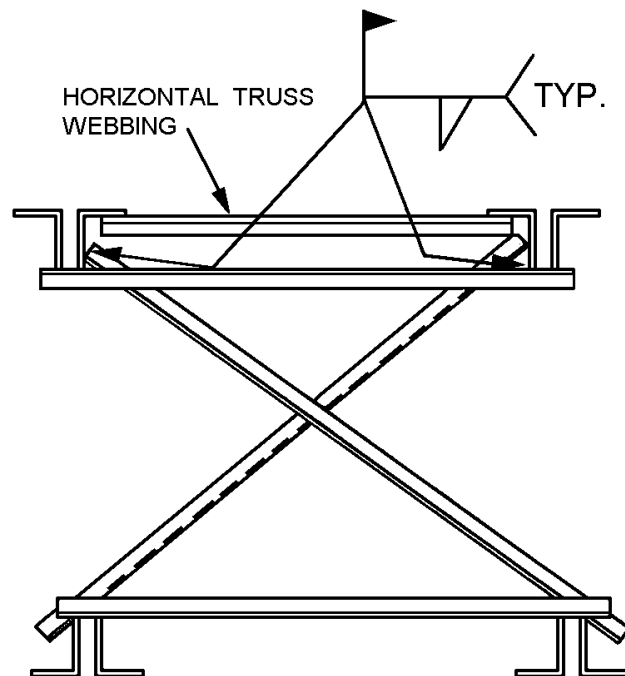


Illustration 10 – JOISTS PAIR BRIDGING – TERMINUS POINT WITH HORIZONTAL TRUSS

WAC 296-155-72406 (Cont.)

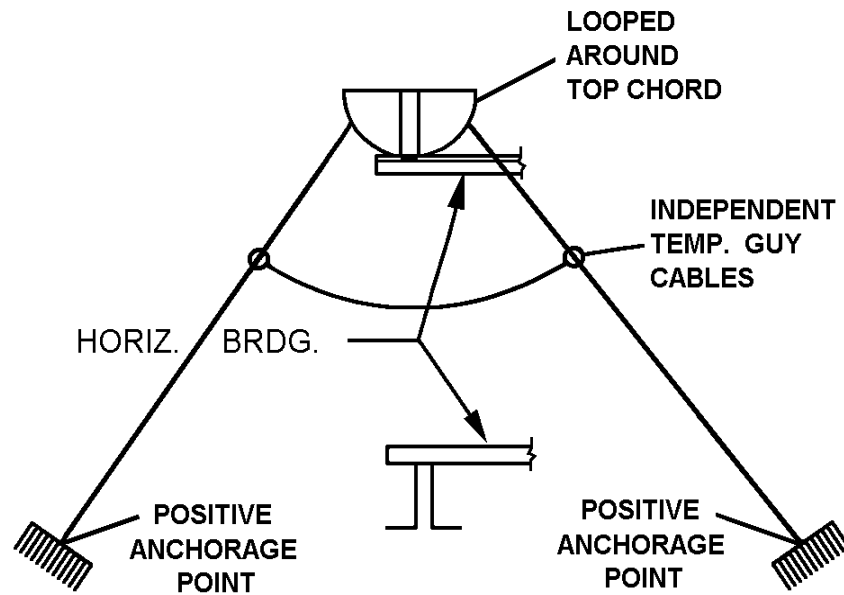


Illustration 11 – **HORIZONTAL BRIDGING - TERMINUS POINT SECURED BY TEMP. GUY CABLES**

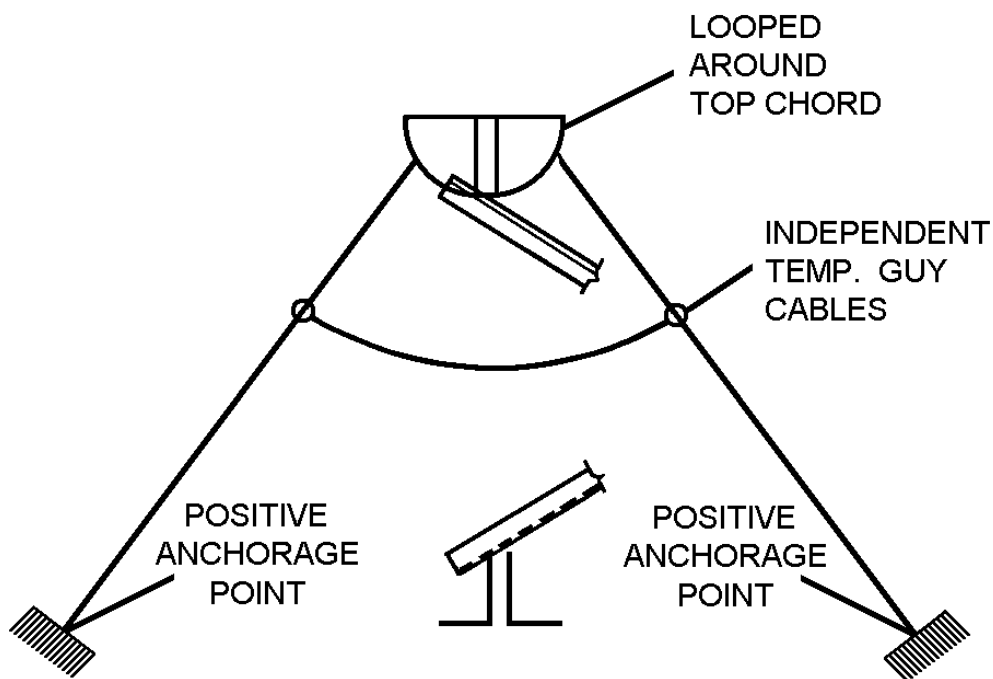


Illustration 12 – **DIAGONAL BRIDGING – TERMINUS POINT SECURED BY TEMP. GUY CABLES**

WAC 296-155-72406 (Cont.)

Employers must comply with fall restraint and fall arrest as stated in Part C-1, chapter 296-155 WAC.

[Statutory Authority: RCW 49.17.010, .040, .050. 02-13-115 (Order 01-36), § 296-155-72406, filed 06/19/02, effective 09/01/02].